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## Building Microservices and a CI/CD Pipeline with AWS

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Project overview and objectives

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In this project, you're challenged to use at least 11 AWS offerings, including some that might be new to you, to build a microservices and continuous integration and continuous development (CI/CD) solution. Throughout various AWS Academy courses, you have completed hands-on labs. You have used different AWS services and features to build a variety of solutions.

In many parts of the project, step-by-step guidance is not provided. This is intentional. These specific sections of the project are meant to challenge you to practice skills that you have acquired throughout your learning experiences prior to this project. In some cases, you might be challenged to use resources to independently learn new skills.

By the end of this project, you should be able to do the following:

Recognize how a Node.js web application is coded and deployed to run and connect to a relational database where the

application data is stored.

Create an AWS Cloud9 integrated development environment (IDE) and a code repository (repo) in which to store the application code.

Split the functionality of a monolithic application into separate containerized microservices.

Use a container registry to store and version control containerized microservice Docker images.

Create code repositories to store microservice source code and CI/CD deployment assets.

Create a serverless cluster to fulfill cost optimization and scalability solution requirements.

Configure an Application Load Balancer and multiple target groups to route traffic between microservices.

Create a code pipeline to deploy microservices containers to a blue/green cluster deployment.

Use the code pipeline and code repository for CI/CD by iterating on the application design.

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This environment is long lived. When the session timer runs to 0:00, the session will end, but any data and resources that you created in the AWS account will be retained. If you later launch a new session (for example, the next day), you will find that your work is still in the lab environment. Also, at any point before the session timer reaches 0:00, you can choose Start Lab again to extend the current session time.

Important: Monitor your lab budget in the lab interface. When you have an active lab session, the latest known remaining

budget information displays at the top of this screen. The remaining budget that you see might not reflect your most recent account activity. If you exceed your lab budget, your lab account will be disabled, and all progress and resources will be lost. If you exceed the budget, please contact your educator for assistance.

If you ever want to reset the lab environment to the original state, before you started the lab, use the Reset option above these instructions. Note that this won't reset your budget. Warning: If you reset the environment, you will permanently delete everything that you have created or stored in this AWS account.

### AWS service restrictions

In this lab environment, access to AWS services and service actions are restricted to the ones that are needed to complete the project. You might encounter errors if you attempt to access other services or perform actions beyond the ones that are described in this lab.

### Scenario

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The owners of a café corporation with many franchise locations have noticed how popular their gourmet coffee offerings have become.

Customers (the café franchise location managers) cannot seem to get enough of the high-quality coffee beans that are needed to create amazing cappuccinos and lattes in their cafés.

Meanwhile, the employees in the café corporate office have been challenged to consistently source the highest-quality coffee beans. Recently, the leaders at the corporate office learned that one of their favorite coffee suppliers wants to sell her company. The café corporate managers jumped at the opportunity to buy the company. The acquired coffee supplier runs a coffee supplier listings application on an AWS account, as shown in the following image.

## scenario

The coffee suppliers application currently runs as a monolithic application. It has reliability and performance issues. That is one of the reasons that you have recently been hired to work in the café corporate office. In this project, you perform tasks that are associated with software development engineer (SDE), app developer, and cloud support engineer roles.

You have been tasked to split the monolithic application into microservices, so that you can scale the services independently and allocate more compute resources to the services that experience the highest demand, with the goal of avoiding bottlenecks. A microservices design will also help avoid single points of failure, which could bring down the entire application in a monolithic design. With services isolated from one another, if one microservice becomes temporarily unavailable, the other microservices might remain available.

You have also been challenged to develop a CI/CD pipeline to automatically deploy updates to the production cluster that runs containers, using a blue/green deployment strategy.

## Solution requirements

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The solution must meet the following requirements:

- R1 - Design: The solution must have an architecture diagram.
- R2 - Cost optimized: The solution must include a cost estimate.
- R3 - Microservices-based architecture: Ensure that the solution is functional and deploys a microservice-based architecture.
- R4 - Portability: The solution must be portable so that the application code isn't tied to running on a specific host

machine.

R5 - Scalability/resilience: The solution must provide the ability to increase the amount of compute resources that are dedicated to serving requests as usage patterns change, and the solution must use routing logic that is reliable and scalable.

R6 - Automated CI/CD: The solution must provide a CI/CD pipeline that can be automatically invoked when code is updated and pushed to a version-controlled code repository.

Lab project tips

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Knowledge of Linux Bash commands would be helpful, but it isn't mandatory.

Tip: One online Linux Bash reference is the Linux Man Pages on [linux.die.net](http://linux.die.net). You can search or browse for commands to learn more about them.

Finally, you are encouraged to be resourceful as you complete this project. For example, reference the AWS Documentation or a search engine if you need an answer to a technical question.

As you work through the project, you will find other tips to help you complete specific phases or tasks.

Approach

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The following table describes the phases of the project:

Phase	Detail	Solution requirement
-------	--------	----------------------

1	Create an architecture diagram and cost estimate for the solution.	R1, R2
---	--	--------

2	Analyze the design of the monolithic application and test the application.	R3
---	--	----

3	Create a development environment on AWS Cloud9, and check the monolithic source code into CodeCommit.	R3
---	---	----

- 4 Break the monolithic design into microservices, and launch test Docker containers. R3, R4
  - 5 Create ECR repositories to store Docker images. Create an ECS cluster, ECS task definitions, and CodeDeploy application specification files. R3
  - 6 Create target groups and an Application Load Balancer that routes web traffic to them. R5
  - 7 Create ECS services. R5
  - 8 Configure applications and deployments groups in CodeDeploy, and create two CI/CD pipelines by using CodePipeline. R5, R6
  - 9 Modify your microservices and scale capacity, and use the pipelines that you created to deploy iterative improvements to production by using a blue/green deployment strategy. R5, R6
- Phase 1: Planning the design and estimating cost
- In this phase, you will plan the design of your architecture. First, you will create an architecture diagram.

You will also estimate the cost of the proposed solution and present the estimate to your educator. An important first step for any solution is to plan the design and estimate the cost. Review the various components in the architecture to adjust the estimated cost. Cost, along with the features and limitations of specific AWS services, is an important factor when you build a solution.

### Task 1.1: Create an architecture diagram

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Create an architectural diagram to illustrate what you plan to build. Consider how you will accomplish each requirement in the solution. Read through the phases in this document to be aware of which AWS services and features you have been asked to use. Be sure to include the following services or resources in your diagram:

Amazon Virtual Private Cloud (Amazon VPC)

Amazon EC2: Instances, Application Load Balancer, target groups



AWS CodeCommit: Repository

AWS CodeDeploy

AWS CodePipeline: Pipeline

Amazon Elastic Container Service (Amazon ECS): Services, containers, tasks

Amazon Elastic Container Registry (Amazon ECR): Repository

AWS Cloud9 environment

AWS Identity and Access Management (IAM): Roles

Amazon Relational Database Service (Amazon RDS)

Amazon CloudWatch: Logs

References

AWS Architecture Icons: This site provides tools to draw AWS architecture diagrams.

AWS Reference Architecture Diagrams: This site provides a list of AWS architecture diagrams for various use cases. You might want to use these diagrams as references.

Task 1.2: Develop a cost estimate

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Develop a cost estimate that shows the cost to run the solution that you created an architecture diagram for. Assume that the solution will run in the us-east-1 Region for 12 months. Use the AWS Pricing Calculator for this estimate.

If instructed by your educator, complete these additional

requirements:

Add your architectural diagram and cost estimate to presentation slides. Your educator might want to evaluate this information as part of assessing your work on this project. A presentation template is provided.

Capture screenshots of your work at the end of each task or phase to include in the presentation or document. Your instructor might use the presentation or document to help assess how well you completed the project requirements.

## Reference

A PowerPoint presentation template is available to you in the course materials.

## Phase 2: Analyzing the infrastructure of the monolithic application

In this task, you will analyze the current application infrastructure and then test the web application.

Task 2.1: Verify that the monolithic application is available  
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Verify that the monolithic web application is accessible from the internet.

Navigate to the Amazon EC2 console.

Copy the Public IPv4 address of the MonolithicAppServer instance, and load it in a new browser tab.

The coffee suppliers website displays.

Note: The page is available at `http://` instead of `https://`. Your browser might indicate that the site isn't secure because it doesn't have a valid SSL/TLS certificate. You can ignore the

warning in this development environment.

## Task 2.2: Test the monolithic web application

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In this task, you add data to the web application, test the functionality, and observe the different URL paths that are used to display the different pages. These URL paths are important to understand for when you divide this application into microservices later.

Choose List of suppliers.

Notice that the URL path includes /suppliers.

Add a new supplier.

On the page where you add a new supplier, notice that the URL path includes /supplier-add.

Fill in all of the fields to create a supplier entry.

Edit an entry.

On the page where you edit a supplier entry, notice that the URL path now includes supplier-update/1.

Modify the record in some way and save the change.

Notice that the change was saved in the record.

## Task 2.3: Analyze how the monolithic application runs

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Use EC2 Instance Connect to connect to the MonolithicAppServer instance.

Analyze how the application is running.

In the terminal session, run the following command:

```
sudo lsof -i :80
```

What did you notice in the command output? What port and protocol is the node daemon using?

Next, run the following command:

```
ps -ef | head -1; ps -ef | grep node
```

What did you notice in the command output? Which user on this EC2 instance is running a node process? Does the node process ID (PID) match any of the PIDs from the output of the command that you ran before the last one?

To analyze the application structure, run the following commands:

```
cd ~/resources/codebase_partner
```

```
ls
```

This is where the index.js file exists. It contains the base application logic, which you will look at in detail in a moment.

Questions for thought: Based on what you have observed, what can you determine about how and where this node application is running? How do you think it was installed? What prerequisite libraries, if any, were required to make it run? Where does the application store data?

Connect a MySQL client to the RDS database that the node application stores data in.

Find and copy the endpoint of the RDS database that is running in the lab environment.

To verify that the database can be reached from the MonolithicAppServer instance on the standard MySQL port number, use the `nmap -Pn` command with the RDS database endpoint that you copied.

To connect to the database, use the MySQL client that is already installed on the MonolithicAppServer instance. Use the following values:

Username: admin

Password: lab-password

Observe the data in the database.

From the `mysql>` prompt, run SQL commands as appropriate to see that a database named COFFEE contains a table named suppliers.

This table contains the supplier entry or entries that you added earlier when you tested the web application.

Exit the MySQL client and then close the EC2 Instance Connect tab. Also close the coffee suppliers web application tab.

## References

Connect to Your Linux Instance with EC2 Instance Connect

Connecting from the MySQL Command-Line Client  
(Unencrypted)

For information about the `ls`, `ps`, `grep`, and `nmap` commands, see the Linux Man Pages on [linux.die.net](https://linux.die.net).

Phase 3: Creating a development environment and checking code into a Git repository

In this phase, you will create a development environment by using AWS Cloud9. You will also check your application code into AWS CodeCommit, which is a Git-compatible repository.

Task 3.1: Create an AWS Cloud9 IDE as your work environment

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In this task, you will create your development environment. If you aren't familiar with AWS Cloud9, the following references might be helpful:

[Creating an Environment in AWS Cloud9](#)

[Tour of the AWS Cloud9 IDE](#)

Create an AWS Cloud9 instance that is named `MicroservicesIDE` and then open the IDE.

It should run as a new EC2 instance of size `t3.small` and run Amazon Linux 2. The instance should support SSH connections and run in the `LabVPC` in `Public Subnet1`.

Task 3.2: Copy the application code to your IDE

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In this task, you will copy the source code for the monolithic application to your development environment.

From the AWS Details panel on this lab instructions page, download the `labsuser.pem` file to your local computer.

Upload the `.pem` file to your AWS Cloud9 IDE, and use the Linux `chmod` command to set the proper permissions on the file so that you can use it to connect to an EC2 instance.

Create a temp directory on the AWS Cloud9 instance at `/home/ec2-user/environment/temp`.

From the Amazon EC2 console, retrieve the private IPv4 address of the `MonolithicAppServer` instance.

Use the Linux `scp` command in the Bash terminal on the AWS Cloud9 instance to copy the source code for the node application from the `MonolithicAppServer` instance to the temp directory that you created on the AWS Cloud9 instance.

The following snippet provides an example `scp` command:

```
scp -r -i ~/environment/labsuser.pem
ubuntu@$appServerPrivIp:/home/ubuntu/resources/codebase_
partner/* ~/environment/temp/
```

In the file browser of the IDE, verify that the source files for the application have been copied to the temp directory on the AWS Cloud9 instance.

Task 3.3: Create working directories with starter code for the two microservices  
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In this task, you will create areas in your development environment to support separating the application logic into two different microservices.

Based on the solution requirements of this project, it makes sense to split the monolithic application into two microservices. You will name the microservices `customer` and `employee`.

The following table explains the functionality that is needed for each microservice.

Primary User	Microservice	Functionality	Access Level
Customer	The customer microservice	will provide the	

functionality that customers (the café franchise location managers who want to buy coffee beans) need. The customers need a read-only view of the contact information for the suppliers to be able to buy coffee beans from them. You can think of the café franchise location managers as customers of the application. Read-only

**Employee** The employee microservice will provide the functionality that employees (the café corporate office employees) need. Employees need to add, modify, and delete suppliers who are listed in the application. Employees are responsible for keeping the listings accurate and up to date.

Read-write

features

The employee microservice will eventually be made available only to employees. You will accomplish this by first encapsulating them as a separate microservice (in phases 3 and 4 of the project), and then later in phase 9 of the project, you will limit who can access the employee microservice.

In the microservices directory, create two new directories that are named customer and employee.

Verify that your directory structure matches the following image:

Cloud9 file panel showing the new directories.

Place a copy of the source code for the monolithic application in each new directory, and remove the files from the temp directory.

Verify that your directory structure matches the following image:

Cloud9 file panel showing the source code files in each new



directory.

Delete the empty temp directory.

Task 3.4: Create a Git repository for the microservices code and push the code to CodeCommit

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You now have directories named `customer` and `employee`, and each will contain a microservice. The two microservices will replicate the logic in your monolithic application. However, you will also be able to evolve the application functionality and to time the deployment of feature enhancements for these microservices separately.

You will benefit from checking this source code into a Git repository. In this project, you will use CodeCommit as your Git repository (repo).

Create a CodeCommit repository that is named `microservices`.

To check the unmodified application code into the `microservices` CodeCommit repository, run the following commands:

```
cd ~/environment/microservices
git init
git branch -m dev
git add .
git commit -m 'two unmodified copies of the application code'
git remote add origin https://git-codecommit.us-east-1.amazonaws.com/v1/repos/microservices
git push -u origin dev
```

Tip: For information about Git commands, see the [Git documentation](#).

Analysis: By running these commands, you first initialized the microservices directory to be a Git repository. Then, you created a branch in the repository named dev. You added all files from the microservices directory to the Git repository and committed them. Then, you defined the microservices repository that you created in CodeCommit as the remote origin of this Git repository area on your IDE. Finally, you pushed the changes that were committed in the dev branch to the remote origin.

Configure your Git client to know your username and email address.

Tip: For information about the commands that you need to use, see [Getting Started - First-Time Git Setup](#).

Note: You don't need to use your real name or email address; however, completing this step is an important part of configuring a Git client.

In a new browser tab, browse to the CodeCommit console and observe that the code is now checked into your microservices repository.

#### Phase 4: Configuring the application as two microservices and testing them in Docker containers

In this phase, you will modify the two copies of the monolithic application starter code so that the application functionality is implemented as two separate microservices. Then, for initial testing purposes, you will run the containers on the same EC2 instance that hosts the AWS Cloud9 IDE that you are using. You will use this IDE to build the Docker images and launch the Docker containers.

#### Task 4.1: Adjust the AWS Cloud9 instance security group settings

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In this phase of the project, you will use the AWS Cloud9

instance as your test environment. You will run Docker containers on the instance to test the microservices that you will create. To be able to access the containers from a browser over the internet, you must open the ports that you will run the containers on.

Adjust the security group of the AWS Cloud9 EC2 instance to allow inbound network traffic on TCP ports 8080 and 8081.

Task 4.2: Modify the source code of the customer microservice  
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In this task, you will edit the source code for the customer microservice. Recall that the source code you are starting with is an exact copy of the monolithic application. Therefore, it still has features in it that will be handled by the employee microservice and that you don't want as part of the customer microservice. Specifically, customers shouldn't have the ability to add, edit, or delete suppliers; therefore, the changes that you make will remove that functionality from the source code. Ideally, the source code should contain only code that is needed.

In the AWS Cloud9 file panel, collapse the employee directory, if it is expanded, and then expand the customer directory.

Edit the `customer/app/controller/supplier.controller.js` file so that the remaining functions provide only the read-only actions that you want customers to be able to perform.

Tip: After you edit the file, it should contain only the following lines:

```
const Supplier = require("../models/supplier.model.js");
```

```

const {body, validationResult} = require("express-validator");

exports.findAll = (req, res) => {
  Supplier.getAll((err, data) => {
    if (err)
      res.render("500", {message: "There was a problem
retrieving the list of suppliers"});
    else res.render("supplier-list-all", {suppliers: data});
  });
};

exports.findOne = (req, res) => {
  Supplier.findById(req.params.id, (err, data) => {
    if (err) {
      if (err.kind === "not_found") {
        res.status(404).send({
          message: `Not found Supplier with id
${req.params.id}`
        });
      } else {
        res.render("500", {message: `Error retrieving Supplier
with id ${req.params.id}`});
      }
    } else res.render("supplier-update", {supplier: data});
  });
};

```

Edit the `customer/app/models/supplier.model.js` file. Delete the unnecessary functions in it so that what remains are only read-only functions.

Important: KEEP the last line of the file: `module.exports = Supplier;`

Note: The model should still contain two functions: `Supplier.getAll` and `Supplier.findById`.

Later in the project, when you deploy the microservices behind an Application Load Balancer, you will want employees to be

able to navigate from the main customer page to the area of the web application where they can add, edit, or delete supplier entries. To support this, edit the customer/views/nav.html file:

On line 3, change Monolithic Coffee suppliers to Coffee suppliers

On line 7, change Home to Customer home

Add a new line after line 8 that contains the following HTML:

Important: DON'T delete or overwrite any of the existing lines in the file.

```
<a class="nav-link" href="/admin/suppliers">Administrator  
link</a>
```

Analysis: Adding this link will provide a navigation path to those pages that will be hosted under the /admin/ URL path.

You don't want customers to see the Add a new supplier button or any edit buttons next to supplier rows. To implement these changes, edit the customer/views/supplier-list-all.html file:

Remove line 32, which contains Add a new supplier.

Remove lines 26 and 27, which contain badge badge-info and supplier-update.

Because the customer microservice doesn't need to support read-write actions, DELETE the following .html files from the customer/views directory:

supplier-add.html

supplier-form-fields.html

supplier-update.html

Edit the customer/index.js file as needed to account for the fact that the node application will now run on Docker containers:

Comment out lines 27 to 37 (ensure that each line starts with `//`).

On line 45, change the port number to 8080

Tip: Recall that when this application ran on the `MonolithicAppServer` instance, it ran on port 80. However, when it runs as a Docker container, you will want the container to run on port 8080.

Task 4.3: Create the customer microservice Dockerfile and launch a test container  
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The following diagram provides an overview of how you will use Docker. Assets that you will use or create are represented by rectangles. Commands that you will use are shown in blue between and above the rectangles.

Diagram of Docker assets you will use or create, and commands you will use.

With the application code base and a Dockerfile, which you will create, you will build a Docker image. A Docker image is a template with instructions to create and run a Docker container. You can think of a Docker image as roughly equivalent to an Amazon Machine Image (AMI) from which you can launch an EC2 instance. A Docker container is roughly equivalent to an EC2 instance. However, Docker images and containers are much smaller.

In the customer directory, create a new file named `Dockerfile` that contains the following code:

```
FROM node:11-alpine
```

```
RUN mkdir -p /usr/src/app
```

```
WORKDIR /usr/src/app
```

```
COPY . .
```

```
RUN npm install
```

```
EXPOSE 8080
```

```
CMD ["npm", "run", "start"]
```

Analysis: This Dockerfile code specifies that an Alpine Linux distribution with Node.js runtime requirements should be used to create a Docker image. The code also specifies that the container should allow network traffic on TCP port 8080 and that the application should be run and started when a container that was created from the image is launched.

Build an image from the customer Dockerfile.

In the AWS Cloud9 terminal, change to the customer directory.

Run the following command:

```
docker build --tag customer .
```

Note: In the output, ignore the npm warning about no repository field.

Notice that the build downloaded the node Alpine starter image and then completed the other instructions as specified in the Dockerfile.

Verify that the customer-labeled Docker image was created.

Run a Docker command to list the Docker images that your Docker client is aware of.

Tip: To find the command that you need to run, see Use the Docker Command Line in the Docker documentation.

Tip: The output of the command should be similar to the following:

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
customer	latest	cdc593c9bf51	59 seconds ago	82.7MB

node 11-alpine f18da2f58c3d 3 years ago 75.5MB

Note: The node image is the Alpine Linux image that you identified in the Dockerfile contents to download and use as the starter image. Your Docker client downloaded it from docker.io. The customer image is the one that you created.

Launch a Docker container that runs the customer microservice on port 8080. As part of the command, pass an environment variable to tell the node application the correct location of the database.

To set a dbEndpoint variable in your terminal session, run the following commands:

```
dbEndpoint=$(cat  
~/environment/microservices/customer/app/config/config.js |  
grep 'APP_DB_HOST' | cut -d '"' -f2)  
echo $dbEndpoint
```

Note: You could manually find the database endpoint in the Amazon RDS console and set it as an environment variable by running `dbEndpoint="<actual-db-endpoint>"` instead of using the cat command.

Important: If you close your AWS Cloud9 terminal or stop and restart the project lab environment, and then need to run a command that uses the `$dbEndpoint` variable, you might need to create the variable again. To test whether the variable is set, run `echo $dbEndpoint`

The following code provides an example of the command you should run that launches a container from the image:

```
docker run -d --name customer_1 -p 8080:8080 -e  
APP_DB_HOST="$dbEndpoint" customer
```

Analysis: This command launched a container named `customer_1` by using the customer image that you created as the template. The `-d` parameter in the command specified that it should run in the background. After the `-p` parameter, the first number specified the port on the AWS Cloud9 instance to publish the container to. The second number indicated the port



that the container is running on in the docker namespace (also port 8080). The `-e` parameter passes the database host location as an environment variable to Docker, which gives the node application the information that it needs to establish network connectivity to the database.

Check which Docker containers are currently running on the AWS Cloud9 instance.

Tip: To find the command that you need to run, see [Use the Docker Command Line](#) in the Docker documentation.

Verify that the customer microservice is running in the container and working as intended.

Load the following page in a new browser tab. Replace the IP address placeholder with the public IPv4 address of the AWS Cloud9 instance that you are using: `http://<cloud-9-public-IPv4-address>:8080`

The web application microservice should load in the browser.

Important: If you stop the lab environment and start it again, the public IPv4 address of the AWS Cloud9 instance will change.

Choose List of suppliers.

Confirm that the supplier entries that you added earlier are displayed.

Note: Although you changed the location where the application runs, it still connects to the same RDS database where the supplier records are stored.

Tip: The Administrator link doesn't work because you haven't created the employee microservice yet.

Confirm that the suppliers page doesn't have Add a new supplier and edit buttons.

Troubleshooting tip: If any functionality is missing, follow these steps: (1) Stop and delete the running container, (2) modify the microservice source code as appropriate, (3) create an updated Docker image from the source code, (4) launch a new test container, and (5) verify whether the functionality is now available. For a list of commands to run to accomplish these steps, see [Updating a test container running on Cloud9 in the appendix of this file](#).

Commit and push your source code changes into CodeCommit.

Tip: You can use the Git source control panel in the AWS Cloud9 IDE, or you can use the `git commit` and `git push` commands in the terminal.

Note: If your educator has asked you to collect information about your solution, be sure to record the commands that you run in this step and the output that was returned.

Optional: Observe the commit details in the CodeCommit console.

In the Commits area of the repository, choose the ID for the most recent commit. Scroll down to see information about what changed in the files since the previous commit.

Notice that deleted lines are shown in red, and added lines are shown in green so that you are able to see every detail of every change to every file that was modified.

Task 4.4: Modify the source code of the employee microservice  
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In this task, you will modify the source code for the employee microservice similarly to how you modified the code for the customer microservice. Customers (café franchise location managers) should have read-only access to the application data, but employees of the café corporate office should be able

to add new entries or modify existing entries in the list of coffee suppliers.

As you will see later in this project, you will deploy the microservices behind an Application Load Balancer and route traffic to the microservices based on the path that is contained in the URL of the request. In this way, if the URL path includes `/admin/`, the load balancer will route the traffic to the employee microservice. Otherwise, if the URL path doesn't include `/admin/`, then the load balancer will route the traffic to the customer microservice.

Because of the need to route traffic, much of the work in this task is to configure the employee microservice to add `/admin/` to the path of the pages that it serves.

In the AWS Cloud9 IDE, return to the file view (toggle tree view).

Collapse the customer directory, and then expand the employee directory.

In the `employee/app/controller/supplier.controller.js` file, for all the redirect calls, prepend `/admin` to the path.

Tip: To find the three lines that need to be updated, run the following commands in the terminal:

```
cd ~/environment/microservices/employee
grep -n 'redirect' app/controller/supplier.controller.js
```

In the `employee/index.js` file, update the `app.get` calls, `app.post` calls, and a port number.

For all `app.get` and `app.post` calls, prepend `/admin` to the first parameter.

Tip: To find the seven lines that need to be updated, run the following command in the terminal:

```
grep -n 'app.get\|app.post' index.js
```

Important: After you edit line 22, the path should be /admin, not /admin/

On line 45, change the port number to 8081

Note: When you run both the customer and employee microservice containers on the AWS Cloud9 instance as a test, they will need to use different port numbers so that they won't conflict with each other.

In the employee/views/supplier-add.html and employee/views/supplier-update.html files, for the form action paths, prepend /admin to the path.

Tip: To find the three lines that need to be updated in the two files, run the following command in the terminal:

```
grep -n 'action' views/*
```

In the employee/views/supplier-list-all.html and employee/views/home.html files, for the HTML paths, prepend /admin to the path.

Tip: To find the three lines that need to be updated in the two files, run the following command in the terminal:

```
grep -n 'href' views/supplier-list-all.html views/home.html
```

In the employee/views/header.html file, modify the title to be Manage coffee suppliers

Edit the employee/views/nav.html file.

On line 3, change Monolithic Coffee suppliers to Manage coffee suppliers

On line 7, replace the existing line of code with the following:

```
<a class="nav-link" href="/admin/suppliers">Administrator  
home</a>
```

Note: Both the href value and the name of the link are

modified in the new line.

Add a new line after line 8 that contains the following HTML:

Important: DON'T delete or overwrite any of the existing lines in the file.

```
<a class="nav-link" href="/">Customer home</a>
```

Analysis: Later in the project, when you deploy the microservices behind an Application Load Balancer, you will want employees to be able to navigate from the admin pages back to the customer area of the web application. Adding this link provides a navigation path for employees to the pages that will be hosted by the customer microservice under the / URL path.

Save the changes.

Task 4.5: Create the employee microservice Dockerfile and launch a test container  
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In this task, you will create a Docker image for the employee microservice. Then, you will launch a test container from the image and verify that the microservice works as expected.

Create a Dockerfile for the employee microservice.

Duplicate the Dockerfile from the customer microservice into the employee microservice area.

Edit the employee/Dockerfile to change the port number on the EXPOSE line to 8081

Build the Docker image for the employee microservice. Specify employee as the tag.

Run a container named `employee_1` based on the `employee` image. Run it on port 8081 and be sure to pass in the database endpoint.

Verify that the `employee` microservice is running in the container and that the microservice functions as intended.

Load the microservice web page in a new browser tab at `http://<cloud9-public-ip-address>:8081/admin/suppliers`

The application should load.

Verify that this view shows buttons to edit existing suppliers and to add a new supplier.

Note: Links that should take you to the customer microservice will not work. For example, if you choose Customer home or Suppliers list, the pages won't be found because the link assumes that the customer microservice also runs on port 8081 (but it doesn't). You can ignore this issue—these links should work as intended when you deploy the microservices to Amazon ECS later.

Test adding a new supplier.

Verify that the new supplier appears on the suppliers page.

Test editing an existing supplier.

Verify that the edited supplier information appears on the suppliers page.

Test deleting an existing supplier:

On the row for a particular supplier entry, choose edit.

At the bottom of the page, choose Delete this supplier, and then choose Delete this supplier again.

Verify that the supplier no longer appears on the suppliers page.

Troubleshooting tip: If any of the functionality mentioned above isn't working as intended, follow these steps: (1) Stop and delete the running container, (2) modify the microservice source code as appropriate, (3) create an updated Docker image from the source code, (4) launch a new test container, and (5) verify whether the functionality is now available. For a list of commands to run to accomplish these steps, see Updating a test container running on Cloud9 in the appendix of this file.

To observe details about both running test containers, run the following command:

```
docker ps
```

Task 4.6: Adjust the employee microservice port and rebuild the image

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When you tested the employee microservice on the AWS Cloud9 instance, you ran it on port 8081. However, when you deploy it to Amazon ECS, you will want it to run on port 8080. To adjust this, you need to modify two files.

Edit the `employee/index.js` and `employee/Dockerfile` files to change the port from 8081 to 8080

Rebuild the Docker image for the employee microservice.

To stop and delete the existing container (assumes that the container name is `employee_1`), run the following command:

```
docker rm -f employee_1
```

Ensure that your terminal is in the employee directory.

Use the docker build command to build a new image from the latest source files that you edited. Use the employee tag.

Tip: If you build an image with the name of an existing image, the existing image will be overwritten.

Note: You don't need to run a new test container, so you don't need to run docker run.

#### Task 4.7: Check code into CodeCommit

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In this task, you will commit and push the changes that you made to the employee microservice to CodeCommit.

Review the updates that you made to the source code. To accomplish this:

Choose the source control icon in the AWS Cloud9 IDE.

Notice the changes list, which indicates which files were changed since you last checked files in to the remote Git repository (CodeCommit).

Choose one of the files that was modified, such as index.js, to compare the version from the last Git commit to the latest version. Changes are highlighted.

This demonstrates a benefit of using a source control system and a Git-compatible IDE such as AWS Cloud9. You can review your code changes prior to committing.

Check your changes into CodeCommit.

Tip: You performed this same type of action in task 4.3. You can accomplish this step by using the Git source control panel, or you can use the git commit and git push commands in the terminal.



Phase 5: Creating ECR repositories, an ECS cluster, task definitions, and AppSpec files

At this point, you have successfully implemented numerous solution requirements. You split the monolithic application into two microservices that can run as Docker containers. You have also verified that the containers support the needed application actions, such as adding, editing, and deleting entries from the database. The microservices architecture still uses Amazon RDS to store the coffee supplier entries.

However, your work isn't finished. There are more solution requirements to implement. The containers are able to run on the AWS Cloud9 instance, but that isn't a scalable deployment architecture. You need the ability to scale the number of containers that run on each microservice up and down depending on need. Also, you need to have a load balancer to route traffic to the appropriate microservice. Finally, you need to be able to easily update each application microservice's codebase independently and roll those changes into production. In the remaining phases of the project, you will work to accomplish these solution requirements.

Task 5.1: Create ECR repositories and upload the Docker images  
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In this phase, you will upload the latest Docker images of the two microservices to separate Amazon ECR repositories.

To authorize your Docker client to connect to the Amazon ECR service, run the following commands:

```
account_id=$(aws sts get-caller-identity |grep Account|cut -d '"'  
-f4)  
echo $account_id  
aws ecr get-login-password --region us-east-1 | docker login --  
username AWS --password-stdin $account_id.dkr.ecr.us-east-
```

1.amazonaws.com

A message in the command output indicates that the login succeeded.

Create a separate private ECR repository for each microservice.

Name the first repository customer

Name the second repository employee

Set permissions on the customer ECR repository.

For information about editing the existing JSON policy, see [Setting a Private Repository Statement in the Amazon ECR User Guide](#).

Replace the existing lines in the policy with the following:

```
{
  "Version": "2008-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": "*",
      "Action": "ecr:*"
    }
  ]
}
```

Use the same approach to set the same permissions on the employee ECR repository.

Tag the Docker images with your unique registryId (account ID) value to make it easier to manage and keep track of these images.

In the AWS Cloud9 IDE, run the following commands:

```
account_id=$(aws sts get-caller-identity |grep Account|cut -d '"'
-f4)
```

```
# Verify that the account_id value is assigned to the $account_id variable
```

```
echo $account_id
```

```
# Tag the customer image
```

```
docker tag customer:latest $account_id.dkr.ecr.us-east-1.amazonaws.com/customer:latest
```

```
# Tag the employee image
```

```
docker tag employee:latest $account_id.dkr.ecr.us-east-1.amazonaws.com/employee:latest
```

Note: The commands don't return output.

Run the appropriate docker command to verify that the images exist and the tags were applied.

Tip: To find the command that you need to run, see Use the Docker Command Line in the Docker documentation.

Tip: The output of the command should be similar to the following image. Notice that the latest tag was applied and that the image names now include the remote repository name where you intend to store it:

Example output of docker images command.

Run the appropriate docker command to push each of the Docker images to Amazon ECR.

Tip: To find the command that you need to run, see Use the Docker Command Line in the Docker documentation.

Tip: Before running the Docker commands, run the following command to set account\_id as a variable in the terminal. Then, when you run the Docker commands, you can reference the account ID as \$account\_id.

```
account_id=$(aws sts get-caller-identity |grep Account|cut -d '"' -f4)
```

Additional tip: The commands that you run should look like the

following commands but with REPLACE\_ME replaced with the correct command:

```
docker REPLACE_ME $account_id.dkr.ecr.us-east-1.amazonaws.com/customer:latest
```

```
docker REPLACE_ME $account_id.dkr.ecr.us-east-1.amazonaws.com/employee:latest
```

The output for each Docker command that you run to push each image to Amazon ECR should look similar to the following:

The push refers to repository [642015801240.dkr.ecr.us-east-1.amazonaws.com/node-app]

006e0ec54dba: Pushed

59762f95cb06: Pushed

22736f780b31: Pushed

d81d715330b7: Pushed

1dc7f3bb09a4: Pushed

dcaceb729824: Pushed

f1b5933fe4b5: Pushed

latest: digest:

sha256:f75b60adddb8d6343b9dff690533a1cd1fbb34ccce6f861e84c857ba7a27b77d size: 1783

Confirm that the two images are now stored in Amazon ECR and that each has the latest label applied.

## Task 5.2: Create an ECS cluster

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In this task, you will create an Amazon ECS cluster.

Create a serverless AWS Fargate cluster that is named `microservices-serverlesscluster`

Ensure that it's configured to use `LabVPC`, `PublicSubnet1`, and `PublicSubnet2` (remove any other subnets). DON'T select

Amazon EC2 instances or ECS Anywhere.

Important: After choosing the button to create the cluster, in the banner that appears across the top of the page, choose View in CloudFormation. Wait until the stack that creates the cluster attains the status `CREATE_COMPLETE` before you proceed to the next task. If the stack fails to create for any reason and therefore rolls back, repeat these steps to try again. It should succeed the second time.

Task 5.3: Create a CodeCommit repository to store deployment files

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In this task, you will create another CodeCommit repository. This repository will store the task configuration specification files that Amazon ECS will use for each microservice. The repository will also store AppSpec specification files that CodeDeploy will use for each microservice.

Create a new CodeCommit repository that is named deployment to store deployment configuration files.

In AWS Cloud9, in the environment directory, create a new directory that is named deployment. Initialize the directory as a Git repository with a branch named dev.

Task 5.4: Create task definition files for each microservice and register them with Amazon ECS

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In this task, you will create a task definition file for each microservice and then register the task definitions with Amazon ECS.

In the new deployment directory, create an empty file named `taskdef-customer.json`

Edit the `taskdef-customer.json` file.

Paste the following JSON code into the file:

```
{
  "containerDefinitions": [
    {
      "name": "customer",
      "image": "customer",
      "environment": [
        {
          "name": "APP_DB_HOST",
          "value": "<RDS-ENDPOINT>"
        }
      ],
      "essential": true,
      "portMappings": [
        {
          "hostPort": 8080,
          "protocol": "tcp",
          "containerPort": 8080
        }
      ],
      "logConfiguration": {
        "logDriver": "awslogs",
        "options": {
          "awslogs-create-group": "true",
          "awslogs-group": "awslogs-capstone",
          "awslogs-region": "us-east-1",
          "awslogs-stream-prefix": "awslogs-capstone"
        }
      }
    }
  ],
}
```

```

    "requiresCompatibilities": [
      "FARGATE"
    ],
    "networkMode": "awsvpc",
    "cpu": "512",
    "memory": "1024",
    "executionRoleArn": "arn:aws:iam::<ACCOUNT-ID>:role/PipelineRole",
    "family": "customer-microservice"
  }

```

Replace a couple values in the file:

On line 37, replace <ACCOUNT-ID> with the actual account ID.

On line 9, replace <RDS-ENDPOINT> with the actual RDS endpoint.

Save the changes.

To register the customer microservice task definition in Amazon ECS, run the following command:

```

aws ecs register-task-definition --cli-input-json
"file:///home/ec2-user/environment/deployment/taskdef-
customer.json"

```

In the Amazon ECS console, verify that the customer-microservice task definition now appears in the Task definitions pane. Also, notice that the revision number displays after the task definition name.

Tip: Consult the ECS documentation if it is helpful.

In the deployment directory, create a taskdef-employee.json specification file.

Add the same JSON code to it that currently exists in the taskdef-customer.json file (where you have already set the account ID and RDS endpoints).

After you paste in the code, change the three occurrences of

customer to employee

To register the employee task definition with Amazon ECS, run an AWS CLI command.

In the Amazon ECS console, verify that the employee-microservice task definition now appears in the Task definitions pane. Also, notice that the revision number displays after the task definition name.

Task 5.5: Create AppSpec files for CodeDeploy for each microservice

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In this task, you will continue to complete tasks to support deploying the microservices-based web application to run on an ECS cluster where the deployment is supported by a CI/CD pipeline. In this specific task, you will create two application specification (AppSpec) files, one for each microservice. These files will provide instructions for CodeDeploy to deploy the microservices to the Amazon ECS on Fargate infrastructure.

Create an AppSpec file for the customer microservice.

In the deployment directory, create a new file named `appspec-customer.yaml`

Paste the following YAML code into the file:

Important: DON'T modify `<TASK_DEFINITION>`. This setting will be updated automatically when the pipeline runs.

```
version: 0.0
```

```
Resources:
```

```
- TargetService:
```

```
  Type: AWS::ECS::Service
```



Properties:

TaskDefinition: <TASK\_DEFINITION>

LoadBalancerInfo:

ContainerName: "customer"

ContainerPort: 8080

Note: This file is in YAML format. In YAML, indentation is important. Verify that the code in your file maintains the indentation levels as shown in the previous code block.

Save the changes.

In the same directory, create an AppSpec file for the employee microservice.

Name the file appspec-employee.yaml.

The contents of the file should be the same as the appspec-customer.yaml file. However, change customer` on thecontainerNameline to beemployee`

Task 5.6: Update files and check them into CodeCommit  
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In this task, you will update the two task definition files. Then, you will push the four files that you created in the last two tasks into the deployment repository.

Edit the taskdef-customer.json file.

Modify line 5 to match the following line:

"image": "<IMAGE1\_NAME>",

Save the change.

Analysis: <IMAGE1\_NAME> is not a valid image name, which is why you originally set the image name to customer before running the AWS CLI command to register the first revision of the file with Amazon ECS. However, at this point in the project, it's important to set the image value to a placeholder text value. Later in this project, when you configure a pipeline, you will identify IMAGE1\_NAME as placeholder text that can be dynamically updated. In summary, CodePipeline will set the correct image name dynamically at runtime.

Edit the taskdef-employee.json file.

Modify line 5 to match the following line:

```
"image": "<IMAGE1_NAME>",
```

Save the change.

Push all four files to CodeCommit.

Note: Pushing the latest files to CodeCommit is essential. Later, when you create the CI/CD pipeline, the pipeline will pull these files from CodeCommit and use the details in them as instructions to deploy updates for your microservices to the Amazon ECS cluster.

## Phase 6: Creating target groups and an Application Load Balancer

In this phase, you will create an Application Load Balancer, which provides an endpoint URL. This URL will act as the HTTPS entry point for customers and employees to access your application through a web browser. The load balancer will have listeners, which will have routing and access rules that determine which target group of running containers the user request should be directed to.

### Task 6.1: Create four target groups

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In this task, you will create four target groups—two for each microservice. Because you will configure a blue/green deployment, CodeDeploy requires two target groups for each deployment group.

Note: Blue/green is a deployment strategy where you create two separate but identical environments. One environment (blue) runs the current application version, and one environment (green) runs the new application version. For more information, see *Blue/Green Deployments in the Overview of Deployment Options on AWS* whitepaper.

Create the first target group for the customer microservice.

Navigate to the Amazon EC2 console.

In the navigation pane, choose Target Groups.

Choose Create target group and configure the following:

Choose a target type: Choose IP addresses.

Target group name: Enter customer-tg-one

Protocol: Choose HTTP.

Port: Enter 8080

VPC: Choose LabVPC.

Health check path: Enter /

Choose Next.

On the Register targets page, accept all defaults (don't register any targets), and choose Create target group.

Create a second target group for the customer microservice.

Use the same settings as the first target group except use customer-tg-two as the target group name.

Create a target group for the employee microservice. Use the same settings as the other target groups with the following exceptions:

Target group name: Enter employee-tg-one

Health check path: Enter /admin/suppliers

Create a second target group for the employee microservice. Use the same settings as the other target groups with the following exceptions:

Target group name: Enter employee-tg-two

Health check path: Enter /admin/suppliers

Important: Carefully confirm the name and port number of each target group. The following image provides an example:

List of the four target groups and their port numbers.

Task 6.2: Create a security group and an Application Load Balancer, and configure rules to route traffic  
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In this task, you will create an Application Load Balancer. You will also define two listeners for the load balancer: one on port 80 and another on port 8080. For each listener, you will then define path-based routing rules so that traffic is routed to the correct target group depending on the URL that a user attempts to load.

Create a new EC2 security group named microservices-sg to use

in LabVPC. Add inbound rules that allow TCP traffic from any IPv4 address on ports 80 and 8080.

In the Amazon EC2 console, create an Application Load Balancer named `microservicesLB`.

Make it internet facing for IPv4 addresses.

Use LabVPC, Public Subnet1, Public Subnet2, and the `microservices-sg` security group.

Configure two listeners on it. The first should listen on HTTP:80 and forward traffic to `customer-tg-two` by default. The second should listen on HTTP:8080 and forward traffic to `customer-tg-one` by default.

Add a second rule for the HTTP:80 listener. Define the following logic for this new rule:

IF Path is `/admin/*`

THEN Forward to... the `employee-tg-two` target group.

The settings should be the same as shown in the following image:

Rules for the HTTP:80 listener.

Add a second rule for the HTTP:8080 listener. Define the following logic for this new rule:

IF Path is `/admin/*`

THEN Forward to the `employee-tg-one` target group.

The settings should be the same as shown in the following image:

Rules for the HTTP:8080 listener.

## Phase 7: Creating two Amazon ECS services

In this phase, you will create a service in Amazon ECS for each microservice. Although you could deploy both microservices to a single ECS service, for this project, it will be easier to manage the microservices independently if each is deployed to its own ECS service.

### Task 7.1: Create the ECS service for the customer microservice

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In AWS Cloud9, create a new file named `create-customer-microservice-tg-two.json` in the deployment directory.

Paste the following JSON code into the file:

```
{
  "taskDefinition": "customer-microservice:REVISION-
NUMBER",
  "cluster": "microservices-serverlesscluster",
  "loadBalancers": [
    {
      "targetGroupArn": "MICROSERVICE-TG-TWO-ARN",
      "containerName": "customer",
      "containerPort": 8080
    }
  ],
  "desiredCount": 1,
  "launchType": "FARGATE",
  "schedulingStrategy": "REPLICA",
  "deploymentController": {
    "type": "CODE_DEPLOY"
  },
  "networkConfiguration": {
    "awsvpcConfiguration": {
      "subnets": [
        "PUBLIC-SUBNET-1-ID",
        "PUBLIC-SUBNET-2-ID"
      ],
```

```
    "securityGroups": [  
        "SECURITY-GROUP-ID"  
    ],  
    "assignPublicIp": "ENABLED"  
  }  
}
```

Edit the create-customer-microservice-tg-two.json file:

Replace REVISION-NUMBER with the number of the latest revision of the customer-microservice task definition that is registered with Amazon ECS.

If this is the first time that you are completing this step, the revision number should be 1.

If you are repeating this step, find the latest revision number in the Amazon ECS console by choosing Task definitions, and then choosing customer-microservice.

Replace MICROSERVICE-TG-TWO-ARN with the actual ARN of the customer-tg-two target group.

Replace PUBLIC-SUBNET-1-ID with the actual subnet ID of Public Subnet1.

Replace PUBLIC-SUBNET-2-ID with the actual subnet ID of Public Subnet2.

Replace SECURITY-GROUP-ID with the actual security group ID of microservices-sg.

Save the changes.

To create the Amazon ECS service for the customer microservice, run the following commands:

```
cd ~/environment/deployment  
aws ecs create-service --service-name customer-microservice --  
cli-input-json file://create-customer-microservice-tg-two.json
```

Troubleshooting tip: If you are repeating this step and previously created the ECS service, you might receive an error about the creation of the service not being idempotent. To resolve this error, force delete the service from the Amazon ECS console, wait for it to drain, and then run the commands again.

Task 7.2: Create the Amazon ECS service for the employee microservice

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Create an Amazon ECS service for the employee microservice.

Copy the JSON file that you created for the customer microservice, and name it `create-employee-microservice-tg-two.json`. Save it in the same directory.

Modify the `create-employee-microservice-tg-two.json` file:

On line 2, change `customer-microservice` to `employee-microservice` and also update the revision number.

On line 6, enter the ARN of the `employee-tg-two` target group.

Tip: Don't just change `customer` to `employee` on this line. The ARN is unique in other ways.

On line 7, change `customer` to `employee`

Save the changes.

Run the appropriate AWS CLI command to create the service in Amazon ECS.

Note: If you go to the Amazon ECS console and look at the services in the cluster, you might see 0/1 Task running, as shown in the following image. This is expected for now because



you haven't launched task sets for these services yet.

after service creation

### Phase 8: Configuring CodeDeploy and CodePipeline

Now that you have defined the Application Load Balancer, target groups, and the Amazon ECS services that comprise the infrastructure that you will deploy your microservices to, the next step is to define the CI/CD pipeline to deploy the application.

The following diagram illustrates the role of the pipeline in the solution that you are building.

Pipeline diagram. See description after image.

Diagram description: The pipeline will be invoked by updates to CodeCommit, where you have stored the ECS task definition files and the CodeDeploy AppSpec files. The pipeline can also be invoked by updates to one of the Docker image files that you have stored in Amazon ECR. When invoked, the pipeline will call the CodeDeploy service to deploy the updates. CodeDeploy will take the necessary actions to deploy the updates to the green environment. Assuming that no errors occur, the new task set will replace the existing task set.

### Task 8.1: Create a CodeDeploy application and deployment groups

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A CodeDeploy application is a collection of deployment groups and revisions. A deployment group specifies an Amazon ECS service, load balancer, optional test listener, and two target groups. A group specifies when to reroute traffic to the replacement task set, and when to terminate the original task set and Amazon ECS application after a successful deployment.

Use the CodeDeploy console to create a CodeDeploy

application with the name microservices that uses Amazon ECS as the compute platform.

Tip: See Create an Application for an Amazon ECS Service Deployment (Console) in the AWS CodeDeploy User Guide.

Important: DON'T create a deployment group yet. You will do that in the next step.

Create a CodeDeploy deployment group for the customer microservice.

On the microservices application detail page, choose the Deployment groups tab.

Choose Create deployment group and configure the following:

Deployment group name: Enter microservices-customer

Service role: Place your cursor in the search box, and choose the ARN for DeployRole.

In the Environment configuration section:

ECS cluster name: Choose microservices-serverlesscluster.

ECS service name: Choose customer-microservice.

In the Load balancers section:

Load balancer: Choose microservicesLB.

Production listener port: Choose HTTP:80.

Test listener port: Choose HTTP:8080.

Target group 1 name: Choose customer-tg-two.

Target group 2 name: Choose customer-tg-one.

In the Deployment settings section:

Traffic rerouting: Choose Reroute traffic immediately.

Deployment configuration: Choose CodeDeployDefault.ECSAllAtOnce.

Original revision termination: Days: 0, Hours: 0, Minutes: 5

Choose Create deployment group.

Create a CodeDeploy deployment group for the employee microservice. Specify the same settings that you did in the prior step, except for the following:

Deployment group name: Enter microservices-employee

ECS service name: Choose employee-microservice.

Target group 1 name: Choose employee-tg-two.

Target group 2 name: Choose employee-tg-one.

Task 8.2: Create a pipeline for the customer microservice  
Return to table of contents

In this task, you will create a pipeline to update the customer microservice. When you first define the pipeline, you will configure CodeCommit as the source and CodeDeploy as the service that is responsible for deployment. You will then edit the pipeline to add the Amazon ECR service as a second source.

With an Amazon ECS blue/green deployment, which you will specify in this task, you provision a new set of containers, which CodeDeploy installs the latest version of your application on. CodeDeploy then reroutes load balancer traffic from an existing set of containers, which run the previous version of your application, to the new set of containers, which run the latest

version. After traffic is rerouted to the new containers, the existing containers can be terminated. With a blue/green deployment, you can test the new application version before sending production traffic to it.

## References

The AWS Academy Cloud Architecting and AWS Academy Cloud Developing courses include hands-on labs that explore CodePipeline features.

## AWS CodePipeline User Guide

In the CodePipeline console, create a customer pipeline with the following settings:

Pipeline name: Enter update-customer-microservice

Service role: Choose the ARN for PipelineRole.

Source provider: Choose AWS CodeCommit.

Repository name: Choose deployment.

Note: You have defined two CodeCommit repositories. The deployment repository contains the Amazon ECS task definition files and CodeDeploy AppSpec files that your pipeline will need, so that is the one you choose here.

Branch name: Choose dev.

Note: Skip the build stage.

Deploy provider: Amazon ECS (Blue/Green)

Region: US East (N. Virginia).

AWS CodeDeploy application name: microservices

AWS CodeDeploy deployment group: microservices-customer

Under Amazon ECS task definition:

Set a SourceArtifact with a value of taskdef-customer.json

Under AWS CodeDeploy AppSpec file:

Set a SourceArtifact with a value of appspec-customer.yaml

Note: Leave the Dynamically update task definition image fields blank for now.

Note: After you create the pipeline, it will immediately start to run and will eventually fail on the Deploy stage. Ignore that for now and continue to the next step.

Edit the update-customer-microservice pipeline to add another source.

In the Edit: Source section, choose Edit stage, then add an action with these details:

Action name: Image

Action provider: Amazon ECR

Repository name: customer

Image tag: latest

Output artifacts: image-customer

Edit the deploy action of the update-customer-microservice pipeline.

Edit the update-customer-microservice pipeline

In the Edit: Deploy section, choose Edit stage, then add an input

artifact as described below:

On the Deploy Amazon ECS (Blue/Green) card, choose the edit (pencil) icon.

Under Input artifacts, choose Add and then choose image-customer.

Note: You should now have SourceArtifact and image-customer as listed input artifacts.

Under Dynamically update task definition image, for Input artifact with image details, choose image-customer.

For Placeholder text in the task definition, enter IMAGE1\_NAME

Analysis: Recall that in a previous phase, you entered the IMAGE1\_NAME placeholder text in the taskdef-customer.json file before you pushed it to CodeCommit. In this current task, you configured the logic that will replace the placeholder text with the actual image name that the source phase of the CodePipeline returns.

Task 8.3: Test the CI/CD pipeline for the customer microservice  
Return to table of contents

In this task, you will test that the CI/CD pipeline for the customer microservice functions as intended.

Important: If you are repeating this task, confirm that all target groups are still associated with the Application Load Balancer. The Reassociate Target Groups with Load Balancer section of the appendix provides more detail.

Launch a deployment of the customer microservice on Amazon ECS on Fargate.

Navigate to the CodePipeline console.

On the Pipelines page, choose the link for the pipeline that is named update-customer-microservice.

To force a test of the current pipeline settings, choose Release change, and then choose Release.

Note: By invoking the pipeline, you created a new revision of the task definition.

Wait for the two Source tasks to show a status of Succeeded - just now.

In the Deploy section, wait for a Details link to appear, and then click the link.

A CodeDeploy page opens in a new browser tab.

Observe the progress in CodeDeploy.

Scroll to the bottom of the page, and notice the Deployment lifecycle events section.

Tip: If you see a "Primary task group must be behind listener" error, refer to the Reassociate Target Groups with Load Balancer section in the appendix.

Within a few minutes, if everything was configured correctly, all of the deployment lifecycle events should succeed. Don't wait for that to happen—move to the next step. Keep this page open.

Load the customer microservice in a browser tab and test it.

Locate the DNS name value of the microservicesLB load balancer, and paste it into a new browser tab.

The customer microservice loads. If it doesn't load, add :8080 to the end of the URL and try again.

Analysis: Recall that your load balancer has two listeners: one on port 80 and another on port 8080. Port 8080 is where the replacement task set will run for the first 5 minutes. Therefore, if you load the :80 URL within the first 5 minutes, the customer microservice page might not load, but you should already see the page at 8080. Then, after 5 minutes, you should see that the microservice is available at both ports.

In the café web application, choose List of suppliers or Suppliers list.

The suppliers page loads. It should not have the edit or add supplier buttons because it is a customer page.

Observe the running tasks in the Amazon ECS console.

Navigate to the Amazon ECS console.

In the clusters list, choose the link for microservices-serverlesscluster.

On the Services tab, notice that the customer-microservice service appears. The Deployments and tasks status will change as the blue/green deployment advances through its lifecycle events.

Choose the Tasks tab.

Here you can see the actual tasks that are running. You might have more than one task running per service that you defined.

Choose the link for one of the listed tasks. You might only have one.

Here you can see the actual container details and the configuration information, such as the IP addresses that are associated with the running container.

Return to the CodeDeploy page that is open in another browser tab.



You should now see that all five steps of the deployment succeeded and the replacement task set is now serving traffic.

Observe the load balancer and target group settings.

In the Amazon EC2 console, choose Target Groups.

You might notice that the customer-tg-two target group is no longer associated with the load balancer. This is because CodeDeploy is managing the load balancer listener rules and might have determined that some of the target groups are no longer needed.

Observe the HTTP:80 listener rules.

The default rule has changed here. The default "if no other rule applies" rule previously pointed to customer-tg-two, but now it points to customer-tg-one. This is because CodeDeploy actively managed your Application Load Balancer.

Observe the HTTP:8080 listener rules.

The two rules still forward to the "one" target groups.

Congratulations! You successfully deployed one of the two microservices to Amazon ECS on Fargate by using a CI/CD pipeline.

Task 8.4: Create a pipeline for the employee microservice  
Return to table of contents

In this task, you will create the pipeline for the employee microservice.

Create a pipeline for the employee microservice with the

following specifications:

Pipeline name: update-employee-microservice

Role ARN: PipelineRole

Source provider: AWS CodeCommit

Repository name: deployment

Branch name: dev

Deploy provider: Amazon ECS (Blue/Green)

AWS CodeDeploy application name: microservices

AWS CodeDeploy deployment group: microservices-employee

Amazon ECS task definition: SourceArtifact

Path: taskdef-employee.json

AWS CodeDeploy AppSpec file: SourceArtifact

Path: appspec-employee.yaml

Add another source to the employee microservice pipeline. Add an action with the following details:

Action name: Image

Action provider: Amazon ECR

Repository name: employee

Image tag: latest

Output artifacts: image-employee

Edit the Amazon ECS (Blue/Green) action in the deploy stage:

Add another input artifact and choose image-employee.

Under Dynamically update task definition image, for Input artifact with image details, choose image-employee.

For Placeholder text in the task definition, enter IMAGE1\_NAME

Task 8.5: Test the CI/CD pipeline for the employee microservice  
Return to table of contents

In this task, you will test the pipeline that you just defined for the employee microservice.

Important: If you are repeating this task, confirm that all target groups are still associated with the Application Load Balancer. The Reassociate Target Groups with Load Balancer section of the appendix provides detail if needed.

Launch a deployment of the employee microservice on Amazon ECS on Fargate.

Use the release change feature to force a test of the pipeline.

Follow the progress in CodeDeploy. Within a few minutes, if everything was configured correctly, all of the Deployment lifecycle events should succeed.

Load the employee microservice in a browser tab.

In the browser tab where the customer microservice is running, choose Administrator link.

You are directed to a page in the format `http://microserviceslb-UNIQUE-NUMBER.us-east-1.elb.amazonaws.com/admin/suppliers`.

The employee microservice loads. If it doesn't load, try adding

:8080 just after amazonaws.com in the URL.

Choose List of suppliers or Suppliers list.

The suppliers page should load. This version of the page should not have the edit or add supplier buttons. All links in the café web application should now work because you have now deployed both microservices.

Observe the running tasks in the Amazon ECS console.

The Deployments and tasks status will change as the blue/green deployment advances through its lifecycle events.

Return to the CodeDeploy page to confirm that all five steps of the deployment succeeded and the replacement task set is now serving traffic.

Congratulations! You successfully deployed the employee microservice to Amazon ECS on Fargate by using a CI/CD pipeline.

Task 8.6: Observe how CodeDeploy modified the load balancer listener rules

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Observe the load balancer and target group settings.

In the Amazon EC2 console, choose Target Groups.

Note: If you already had the page open, refresh it.

Notice that the customer-tg-two target group is no longer associated with the load balancer. This is because CodeDeploy is managing the load balancer listener rules.

Note: If you are repeating this step, the target groups that are currently attached and unattached might be different.

Observe the HTTP:80 listener rules.

The default rule has changed here. For the default "If no other rule applies" rule, the "forward to target group" previously pointed to customer-tg-two, but now it points to customer-tg-one.

Observe the HTTP:8080 listener rules.

The two rules still forward to the "one" target groups.

Phase 9: Adjusting the microservice code to cause a pipeline to run again

In this phase, you will experience the benefits of the microservices architecture and the CI/CD pipeline that you built. You will begin by adjusting the load balancer listener rules that are related to the employee microservice. You will also update the source code of the employee microservice, generate a new Docker image, and push that image to Amazon ECR, which will cause the pipeline to run and update the production deployment. You will also scale up the number of containers that support the customer microservice.

Task 9.1: Limit access to the employee microservice

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In this task, you will limit access to the employee microservice to only people who try to connect to it from a specific IP address. By limiting the source IP to a specific IP address, only users who access the application from that IP can access the pages, and edit or delete supplier entries.

Confirm that all target groups are still associated with the Application Load Balancer.

In the Amazon EC2 console, check that all four target groups are still associated with the load balancer. Reassociate target groups as needed before going to the next step.

Tip: For details, see Reassociating target groups with the load balancer in the appendix.

Discover your public IPv4 address.

Tip: One resource you can use to do this is <https://www.whatismyip.com>.

Edit the rules for the HTTP:80 listener.

For the rule that currently has "IF Path is /admin/\*" in the details, add a second condition to route the user to the target groups only if the source IP of the request is your IP address.

Tip: For the source IP, paste in your public IPv4 address and then add /32. The following image shows an example:

Example of a source IP.

Edit the rules for the HTTP:8080 listener.

Edit the rules in the same way that you edited the rules for the HTTP:80 listener. You want access to the employee target groups to be limited to your IP address.

Task 9.2: Adjust the UI for the employee microservice and push the updated image to Amazon ECR  
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In this task, you will adjust the deployed microservices.

Edit the employee/views/nav.html file.

On line 1, change navbar-dark bg-dark to navbar-light bg-light

Save the change.

To generate a new Docker image from the employee microservice source files that you modified and to label the image, run the following commands:

```
docker rm -f employee_1
cd ~/environment/microservices/employee
docker build --tag employee .
dbEndpoint=$(cat
~/environment/microservices/employee/app/config/config.js |
grep 'APP_DB_HOST' | cut -d '"' -f2)
echo $dbEndpoint
account_id=$(aws sts get-caller-identity |grep Account|cut -d '"'
-f4)
echo $account_id
docker tag employee:latest $account_id.dkr.ecr.us-east-
1.amazonaws.com/employee:latest
Push an updated image to Amazon ECR so that the update-
employee-microservice pipeline will be invoked.
```

In the CodePipeline console, navigate to the details page for the update-employee-microservice pipeline. Keep this page open.

To push the new employee microservice Docker image to Amazon ECR, run the following commands in your AWS Cloud9 IDE:

```
#refresh credentials in case needed
aws ecr get-login-password --region us-east-1 | docker login --
username AWS --password-stdin $account_id.dkr.ecr.us-east-
1.amazonaws.com
#push the image
docker push $account_id.dkr.ecr.us-east-
1.amazonaws.com/employee:latest
Confirm that the output is similar to the following.
```

b20e9725db21: Pushed

715b0f96c609: Pushed

44141cf9260f: Layer already exists

d81d715330b7: Layer already exists

1dc7f3bb09a4: Layer already exists

dcaceb729824: Layer already exists

f1b5933fe4b5: Layer already exists

At least one layer should indicate that it was pushed, which indicates that the image was modified since it was last pushed to Amazon ECR. You could also look in the Amazon ECR repository to confirm the last modified timestamp of the image that is tagged as the latest.

Task 9.3: Confirm that the employee pipeline ran and the microservice was updated

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Observe the update-employee-microservice pipeline details in the CodePipeline console.

Notice that when you uploaded a new Docker image to Amazon ECR, the pipeline was invoked and ran. Note that the pipeline might take a minute or two to notice that the Docker image was updated before the pipeline is invoked.

Observe the details in the CodeDeploy console.

Task 9.4: Test access to the employee microservice

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In this task, you will test access to the employee microservice.



Test access to the employee microservice pages at `http://<alb-endpoint>/admin/suppliers` and `http://<alb-endpoint>:8080/admin/suppliers` from the same device that you have used for this project so far. Replace `<alb-endpoint>` with the DNS name of the microservicesLB load balancer.

At least one of the two pages should load successfully.

Notice that the banner with the page title is a light color now because of the change that you made to the `nav.html` file. Pages that are hosted by the customer microservice still have the dark banner. This demonstrates that by using a microservices architecture, you could independently modify the UI or features of each microservice without affecting others.

Test access to the same employee microservice pages from a different device.

For example, you could use your phone to connect from the cellular network and not the same Wi-Fi network that your computer uses. You want the device to use a different IP address to connect to the internet than your computer.

You should get a 404 error on any page that loads, and the page should say "Coffee suppliers" instead of "Manage coffee suppliers." This is evidence that you cannot successfully connect to the employee microservice from another IP address.

Tip: If you don't have another network available, run the following command in the AWS Cloud9 terminal: `curl http://<alb-endpoint>/admin/suppliers`. The source IP address of the AWS Cloud9 instance is different than your browser's source IP. The result should include `<p class="lead">Sorry, we don't seem to have that page in stock</p>`.

This proves that the updated rules on the load balancer listener are working as intended.

Tip: If the update doesn't function as intended, you could go to

the Deployments page in the CodeDeploy console within 5 minutes to stop the deployment and roll back to the previous version. You would choose Stop and roll back deployment and then choose Stop and rollback. This action would reroute production traffic to the original task set and then delete the replacement task set. You configured the 5-minute setting in phase 8, task 1.

#### Task 9.5: Scale the customer microservice

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In this task, you will scale up the number of containers that run to support the customer microservice. You can make this change without causing the update-customer-microservice pipeline to run.

Update the customer service in Amazon ECS.

Run the following command:

```
aws ecs update-service --cluster microservices-serverlesscluster  
--service customer-microservice --desired-count 3
```

A large JSON-formatted response is returned.

Go to the Amazon ECS services view.

It might look similar to the following image.

Microservices listed in the Amazon ECS console.

In this example, the customer-microservice shows 1/3 tasks running because you increased the desired count from 1 to 3, but the two new containers are still being started. If you wait long enough and look at the Tasks tab, you will see that three containers run to support the customer microservice. This demonstrates how you can scale microservices independently

of one another.

Note: The employee-microservice might show 2/1 tasks running. This could happen because a replacement task set (which has one container) has been created, but the original task set remains active for the first 5 minutes in case you decide to roll back.

### Ending your session

Reminder: This is a long-lived lab environment. Data is retained until you either use the allocated budget or the course end date is reached (whichever occurs first).

To preserve your budget when you are finished for the day, or when you are finished actively working on the assignment for the time being, do the following:

At the top of this page, choose **End Lab**, and then choose **Yes** to confirm that you want to end the lab.

A message panel indicates that the lab is terminating.

Note: Choosing **End Lab** in this environment will not delete the resource you have created. They will still be there the next time you choose **Start lab** (for example, on another day).

To close the panel, choose **Close** in the upper-right corner.

### Appendix

Updating a test container that is running on AWS Cloud9

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If you need to update the source code of a microservice after running the container, you need to (1) stop and delete the

container, (2) build a new image, and (3) run the new image. The following sections provide a reference to complete these steps.

Updating the customer container that is running on AWS Cloud9

```
# Stop and delete the specified container (assumes that the  
container name is customer_1)  
docker rm -f customer_1
```

```
# Must be in the directory that has the Dockerfile before you  
attempt to build a new image  
cd ~/environment/microservices/customer
```

```
# Build a new image from the latest source files and overwrite  
any existing image  
docker build --tag customer .
```

```
# Ensure the dbEndpoint variable is set in your terminal session  
dbEndpoint=$(cat  
~/environment/microservices/customer/app/config/config.js |  
grep 'APP_DB_HOST' | cut -d '"' -f2)  
echo $dbEndpoint
```

```
# Create and run a new container from the image (and pass the  
DB location to the container)  
docker run -d --name customer_1 -p 8080:8080 -e  
APP_DB_HOST="$dbEndpoint" customer
```

```
# URL to test the microservice running on the AWS Cloud9 test  
container
```

```
echo "Customer microservice test container running at  
http://$(curl ifconfig.me):8080
```

Updating the employee container that is running on AWS Cloud9

```
# Stop and delete the specified container (assumes that the  
container name is employee_1)  
docker rm -f employee_1
```

```
# Must be in the directory that has the Dockerfile before you
```

attempt to build a new image

```
cd /home/ec2-user/environment/microservices/employee
```

# Build a new image from the latest source files and overwrite any existing image

```
docker build --tag employee .
```

# Ensure the dbEndpoint variable is set in your terminal session

```
dbEndpoint=$(cat
```

```
~/environment/microservices/customer/app/config/config.js |
```

```
grep 'APP_DB_HOST' | cut -d '"' -f2)
```

```
echo $dbEndpoint
```

# Create and run a new container from the image (and pass the DB location to the container)

```
docker run -d --name employee_1 -p 8081:8081 -e
```

```
APP_DB_HOST="$dbEndpoint" employee
```

# URL to test the microservice running on the AWS Cloud9 test container

```
echo "Employee microservice test container running at
```

```
http://$(curl ifconfig.me):8081/admin/suppliers
```

Reference: Other Docker commands

To find the commands that you need to run, see Use the Docker Command Line in the Docker documentation.

The following selected commands could be helpful:

```
docker container ls # List the running containers
```

```
docker rm -f <container> # Stop and delete the specified container
```

```
docker images # List the images
```

```
docker build --tag <tag-for-image> . # Create a new image from a Dockerfile (must be in the same directory as the Dockerfile)
```

```
docker run -d --name <name-to-give-container> -p <port>:
```

```
<port> <image-tag> # Run a container from an image
```

```
docker ps # List the running Docker containers
```

Reference: Network analysis and viewing Docker logs

# Helpful commands to see what is happening

```
sudo lsof -i :8080
sudo lsof -i :8081
ps -ef | head -1; ps -ef | grep docker

# Docker log viewing - returns container numbers
sudo ls /var/lib/docker/containers

# View the log for a container where you know the container
number
sudo less /var/lib/docker/containers/<container-number>/*.log

# See the IP addresses that Docker containers use
docker inspect network bridge
Reassociating target groups with the load balancer
Return to table of contents
```

Because CodeDeploy manages the Application Load Balancer rules, you might periodically find that some target groups are no longer associated with the load balancer. The following steps explain how to reassociate the target groups.

Note the original configuration that you made for the HTTP:80 listener.

The following image shows the original configuration for this listener:

original HTTP:80 rules

If you successfully deployed the microservices previously, and the settings that are shown in the previous image are currently in use for the deployment (where the target groups in use by the HTTP:80 listener have "two" in their names), then this time you want to set the HTTP:80 listener to use target groups that have "one" in their names. Effectively, the green task set has become the blue task set, and the blue task set has become the green task set.

Edit the HTTP:80 load balancer rules to make sure that they still match the previous image. If they don't, adjust them:

Navigate to the Amazon EC2 console.

In the navigation pane, choose Load Balancers.

Choose the link for the microservicesLB load balancer.

On the Listeners and rules tab, choose the HTTP:80 link.

In the Listener rules panel, verify that the Default rule forwards to customer-tg-one. If it doesn't:

Select the rule.

From the Actions menu, choose Edit rule.

Set Forward to target group to customer-tg-one, and choose Save changes.

Still on the HTTP:80 page, in the Listener rules panel, verify that the rule with Path Pattern is /admin/ forwards to employee-tg-one. If it doesn't:

Select the rule.

From the Actions menu, choose Edit rule, and then choose Next.

In the Actions panel, set Forward to target group to employee-tg-one.

Choose Next, and then choose Save changes.

Note the original configuration that you made for the HTTP:8080 listener.

The following image shows the original configuration for this listener:

original HTTP:8080 rules

If you successfully deployed the microservices previously, and the settings that are shown in the previous image are currently in use for the deployment (where the target groups in use by the HTTP:8080 listener have "one" in their names), then this time you want to set the HTTP:8080 listener to use target groups that have "two" in their names.

Edit the HTTP:8080 load balancer rules to make sure that they still match the previous image. If they don't, adjust them:

Navigate to the Amazon EC2 console.

In the navigation pane, choose Load Balancers.

Choose the link for the microservicesLB load balancer.

On the Listeners and rules tab, choose the HTTP:8080 link.

In the Listener rules panel, verify that the Default rule forwards to customer-tg-two. If it doesn't:

Select the rule.

From the Actions menu, choose Edit rule.

Set Forward to target group to customer-tg-two, and choose Save changes.

Still on the HTTP:8080 page, in the Listener rules panel, verify that the rule with Path Pattern is /admin/ forwards to employee-tg-two. If it doesn't:

Select the rule.

From the Actions menu, choose Edit rule, and then choose Next.

In the Actions panel, set Forward to target group to employee-tg-two.



Choose Next, and then choose Save changes.

Confirm that all target groups are reassociated.

In the navigation pane of the Amazon EC2 console, choose Target Groups.

Confirm that all four target groups are now associated with the microservicesLB load balancer.

Important: Each time that you run the pipelines, start by confirming that all four target groups are associated with the load balancer listeners and adjust as necessary.

In a production environment, you might choose to automate the steps that you just completed, where you want to check and adjust the Application Load Balancer configuration prior to each run of a pipeline. CodeDeploy provides a feature named AppSpec hooks that you can use to create a custom AWS Lambda function with code to accomplish tasks like this. You can then specify that the hook be run before, during, or after a specific lifecycle event by referencing it in your AppSpec definition. Authoring a custom Lambda function and using this feature is beyond the scope of this project. For more information, see AppSpec 'hooks' Section in the AWS CodeDeploy User Guide.

Troubleshooting tips

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Issue: Records from the database don't display in the web application or microservice.

Check the following:

If this happens when you deploy to Amazon ECS, look in the Amazon CloudWatch logs for error details. You might try rebooting the Amazon RDS database.

If this happens when you test running a container on the AWS Cloud9 instance, verify that your AWS Cloud9 instance is running in Public Subnet1.

Issue: Invalid action configuration

Check the following:

The artifact cannot be larger than 3 MB. Look at the codepipeline-xxxx bucket in Amazon S3. Browse to the update-customer-micr/SourceArti or update-employee-micr/SourceArti prefix (folder). Verify that no object is larger than 3 MB. Only push files to the CodeCommit repository if they were mentioned in these instructions. Avoid posting files other than the AppSpec and task definition files to this repository.

Issue: A message in Deployments and tasks in the Amazon ECS console says service....-microservice is unable to consistently start tasks successfully.

Check the following:

Verify that all target groups are associated with the load balancer.

Issue: The CodeDeploy deployment status is stuck at step 1, or the application doesn't work when deployed to Amazon ECS.

Check the following:

In the Amazon ECS console, choose the link for microservices-serverlesscluster. Choose the name of the service (employee-microservice or customer-microservice) that is stuck. Then, choose the Deployments and events tab. This view shows the progress of CodeDeploy deploying the task set. The Configuration and tasks tab can also provide helpful

information because it shows whether any tasks (containers) have actually launched.

In the AWS CloudTrail console, in the navigation pane, choose Event history. Look for events that might have resulted in errors. To observe details for an event, choose the Event name link for the event.

In the CloudWatch console, in the navigation pane, choose Logs and then choose Log groups. Choose the link for the awslogs-capstone log group. To see detailed logs, choose the Log stream link for the latest event time.

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#### Semester Project Instructions:

Dear Students, Your instructor Dr. Zunnurain Hussain has shared the Semester Project Rubric. Please read each point carefully and follow all requirements.

#### Project Requirements:

Find a unique scenario related to your domain/topic.

Each group must search and select one scenario on their own.

You already have access to the AWS platform Start doing from AWS Academy Lab Project - Microservices and CI/CD Pipeline Builder [140080].

Search and include the complete system architecture for your selected scenario.

Prepare the following details clearly on the first page

Student Names

Registration Numbers

Selected Scenario Title

Screenshot/Photo of Selected Scenario

Scenario Approval:

All groups must get their scenarios approved next week.

**Group Size:**

Maximum 2 members per group.

No third member will be allowed.

**Project Structure (Document Requirements):**

Front Page

Table of Contents

List of Figures

List of Tables

Project Summary

Complete Report of the Topic/Scenario

Architecture Diagram

Prompts (in a separate PDF file)

Everyone must have different prompts and different reports.

**Implementation Requirements:**

After completing the project, submit a 2-minute screen recording showing your implementation.

Each member must show their own part of the work.

**Team Collaboration:**

Work must be divided between both members.

Each task must have date-wise evidence of who completed what.

**Final Presentation & Deployment:**

You will present and deploy your project at the end of the semester.

**Reminder:**

Select your project title, prepare your architecture diagram, and bring your scenario for approval next week.

**SEMESTER PROJECT RUBRIC (AWS-BASED IMPLEMENTATION)**

Total Marks: 100

**1. PROJECT PROPOSAL, EXECUTIVE SUMMARY & PROBLEM DEFINITION — 15**

Marks

Criteria Excellent (13–15) Good (10–12)

Satisfactory  
(7–9)

Poor (0–6)

Executive  
Summary

Clear, concise, gives  
complete high-level  
view of problem,  
solution, AWS  
implementation &  
outcomes.

Good  
summary;  
minor gaps.

Basic overview;  
unclear or  
incomplete.

Missing or  
poorly  
written.

Introduction Rich context,  
background, domain  
relevance clearly  
presented.

Good intro;  
missing some  
background.

General intro;  
lacks depth.

No proper  
introduction.

Problem  
Statement

Clearly defines real-  
world problem with  
strong justification & relevance.

Well-defined  
but could be  
stronger.

Vague but  
understandable.

Not defined  
or irrelevant.

Aim &  
Objectives

Precise, measurable,  
aligned with AWS  
architecture.

Mostly  
aligned with  
minor clarity  
issues.

Broad or vaguely  
described.

Missing or  
unclear.

## 2. AWS ARCHITECTURE DESIGN, IMPLEMENTATION STEPS

## & SCREENSHTS — 30

### Marks

#### Complete Implementation Steps (MANDATORY):

Must include step-by-step screenshots for:

- ☐ AWS account setup
- ☐ IAM roles & policies
- ☐ VPC/subnets/security groups
- ☐ EC2, S3, Lambda, DynamoDB, RDS, API Gateway, or any used service
- ☐ Deployment process
- ☐ Testing workflow
- ☐ Monitoring / logging (CloudWatch)
- ☐ Final output

#### Criteria Excellent

(27–30)

#### Good

(22–26)

#### Satisfactory

(15–21)

#### Poor (0–14)

#### AWS

#### Architecture

#### Diagram

#### Professional

#### AWS-standard

diagram with

correct icons &

data flows.

#### Clear

diagram;

minor

mistakes.

Basic diagram;  
missing elements.

No  
architecture or  
incorrect  
icons.

Step-by-Step  
Implementation

Fully detailed  
steps,  
commands,  
configs,  
workflows +  
screenshots for  
each phase.

Good steps +  
most  
screenshots  
present.

Steps partially  
described,  
missing  
screenshots.

No steps or  
screenshots.

Correct Use of  
AWS Services

Services chosen  
logically,  
configured  
securely,  
optimized.



Good service  
use; few  
gaps.

Limited or basic  
implementation.

Wrong or  
incomplete  
configuration.

Security & IAM Follows least  
privilege, VPC  
isolation,  
encryption,  
logging.

Good  
controls;  
some gaps.

Basic controls  
only.

Missing or  
incorrect  
security.

### 3. TECHNICAL REPORT (TOC, LOF, LOT, LOE & REFERENCES) — 25 Marks

#### Required Components (Mandatory)

- ✓ Table of Contents
- ✓ List of Figures
- ✓ List of Tables
- ✓ List of Equations (if applicable)
- ✓ Traceable References (APA/IEEE)

Criteria Excellent (22–25) Good  
(18–21)

Satisfactory

(12–17)

Poor (0–11)

Report  
Organization

Complete with all  
required lists; clean  
formatting.

Minor  
formatting  
gaps.

Some lists  
missing or  
unclear.

Little or no  
structure.

Technical  
Depth &  
Writing  
Quality

Deep analysis,  
correct  
terminology,  
diagrams,  
explanations.

Good  
quality;  
slight gaps.  
Basic  
descriptions;  
lacks clarity.

Incorrect or  
unstructured  
writing.

References &  
Citation  
Quality

All references  
properly cited,  
traceable, credible.

Some minor  
citation  
errors.

Few references,  
inconsistently  
formatted.

No references  
or incorrect  
style.

4. POWERPOINT PRESENTATION — 10 Marks  
Criteria Excellent (9–10) Good  
(7–8)

Satisfactory  
(5–6)

Poor (0–4)

Content &  
Communication

Covers executive  
summary, problem,  
architecture,  
implementation, results.

Covers  
main areas  
but missing  
depth.

Limited  
details.

Incomplete  
or unclear.

Visual Quality Clean layout, correct  
AWS icons, consistent  
formatting.

Good  
visuals;  
minor  
issues.

Basic slides;  
cluttered.

Poorly  
designed  
slides.

## 5. VIDEO DEMO / SCREEN RECORDING — 10 Marks

Criteria Excellent (9–10) Good (7–8) Satisfactory  
(5–6)

Poor (0–4)

End-to-End  
Demonstration

Shows full  
deployment, working  
output, AWS

console view.

Mostly  
complete  
demo.

Partially  
shown.



Very poor or  
missing demo.

Clarity of  
Explanation

Strong narration;  
clear steps.

Good  
explanation.

Minimal  
clarity.

No  
explanation.

6. MARKETING POSTER DESIGN — 5 Marks  
Criteria Excellent (5) Good (4) Satisfactory

(3)

Poor (0–2)

Design &  
Creativity

Highly attractive,  
professional, AWS-themed.  
Good

design.

Average  
poster.

Poor design.

Content  
Accuracy

Shows purpose, features,  
architecture highlights.

Mostly  
accurate.

Limited  
content.

Missing key  
content.

7. PROMPTS LOG PDF — 5 Marks  
Criteria Excellent (5) Good (4) Satisfactory

(3)

Poor (0–2)

Completeness of  
Prompt Log

Includes all prompts  
used for report, PPT,  
poster, code.

Mostly  
complete.

Missing many

prompts.

Not  
submitted.

umar.ah started the group chat with a group link.

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Invite with link

Ali Hasnain joined the group chat.

Bhai gpt Hume guide kre

ChatGPT

Bilkul bhai, main yahan hoon — **poori guidance dunga.**

Aap dono ne itni lambi AWS project details bheji hain. Pehle mujhe yeh batao:

✅ **Aapko exactly kis cheez par guidance chahiye abhi?**

1. Scenario choose karna?
2. Semester project ko AWS Academy project jaisa convert karna?
3. Architecture diagram banana?
4. Report / PPT / poster banwana?
5. Pure project ko step-by-step samajhna?

Bas batao kahan se start karna hai, main turant aapka project shape kar deta hoon.

Bhai Hume Bata option 1, 4, 6 or 10 me se Kon sa better rahe gaa,  
concept wise, presentation wise or uniqueness k hisaab se Jo hrr Kisi ki  
hakeri nikaal de

ChatGPT

Bhai **perfect sawaal** — main tum dono ko bilkul clear, honest comparison de deta hoon so  
you pick the **strongest, most unique** scenario jo presentation, viva, documentation sab  
mein **top-class impression** de.

Neeche **Option 1, 4, 6, 10** ka deep comparison hai:

## ★ Quick Summary — Best Choice: OPTION 6 (Real Estate Microservices System)

But neeche full comparison hai taake aap dono confidently choose karo.

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explain your idea and tools you plan to use. FOR every project

ChatGPT

Theek hai bhai, ab main **har project option ka idea + tools** clear clear likh deta hoon, taake aap teacher ko bhi easily explain kar sako.

⚠ Note: Final implementation aap log **sirf 1 scenario** pe karoge, lekin approval ke liye ye list ideas strong lagengi.

## ◆ Common AWS Stack (Almost sab projects mein ye use hoga)

Har scenario mein hum ye core AWS services use karenge:

- **VPC. Subnets. Security Groups** – secure network banane ke liye

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Real Estate Listings Microservices System

Agents update listings, customers browse properties.



Explain this in context of project, Architecture etc.



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Scene set karte hain:

**Project title:** Real Estate Listings Microservices System

**Tagline jo teacher ko bol sakte ho:**

"Humne ek scalable real-estate portal banaya hai jahan customers properties browse karte hain aur agents apni listings manage karte hain, using AWS microservices + CI/CD."

## 1 Idea in simple words (for proposal / viva)

- Hum ek real estate portal bana rahe hain, jaisa Zameen.com / Property Finder type concept

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Wah jee wah, aese kaam puchte nhi bss kr dete hai

Wah jee wah, aese kaam puchte nhi bss kr dete hai

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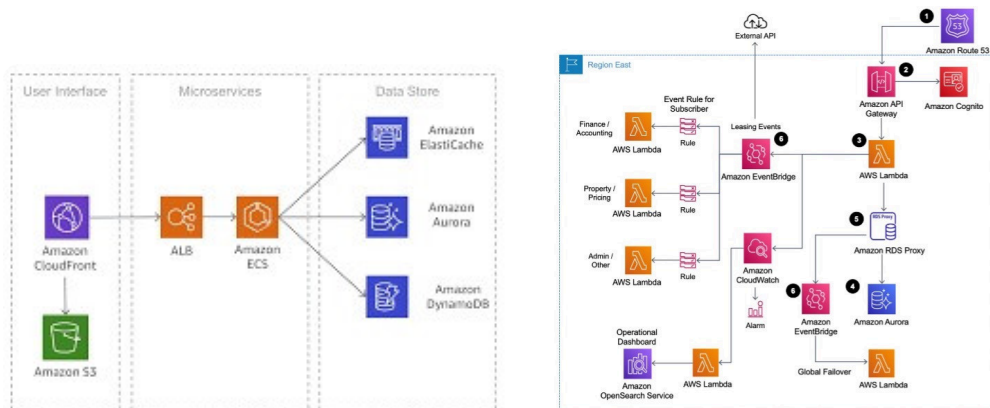
ChatGPT

Bilkul bhai — yeh lo **Executive Summary + Problem Statement** *Real Estate Listings Microservices System* ke liye, bilkul project-ready wording mein.  
(Teacher ko de do → direct approve ho jayega.)

## Executive Summary

This project presents a **Real Estate Listings Microservices System** designed and deployed using **AWS Cloud services**, following a scalable, secure, and fully automated CI/CD architecture. The objective is to modernize a traditional monolithic property-listing system

Show more



Inn k baare me Kya khyaal hai

ChatGPT

Bhai, dono architectures bohot solid hain, lekin tumhare semester project ke scope (ECS, ECR, ALB, CodePipeline, CodeDeploy, Cloud9, RDS) ke hisaab se evaluate karta hoon:

## ✅ 1) Pehla Architecture (CloudFront → S3 → ALB → ECS → Databases)

### ✅ BEST MATCH for Your Project

Kyunki tumhara AWS Academy project ECS Fargate, ALB, ECR, CI/CD pipelines, Docker microservices par based hai

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But is mai ye issue hai k ye bohat simple na hojaye

ChatGPT 1:12 PM

Bilkul valid point bhai, **ye wala simple "lag" sakta hai** agar sirf 3 blocks bana do.  
Lekin good news: **tumhara actual project simple nahi hai at all** – usme already kaafi heavy cheezen hain. Hum sirf diagram ko **thoda pro level** dikhana hai.

Main do cheezen clear karta hoon:

---

## **1** Ye project simple *nahi* hai (jo cheezen tum already karoge)

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